The March 2015

# Giovanni News

**From the Editor:**

Hello again. This month's issue is devoted to six interesting journal papers selected from the latter half of 2014, each of which describes research that utilized the Geospatial Interactive Online Visualization ANd ANalysis Infrastructure (Giovanni). The paper topics are wide-ranging, from dust, disease, weather, and climate, to rainfall in China and jellyfish in Chile. We hope you find our summaries of these papers interesting.

Next month, we'll catch up with the rapid pace of development of, and data variable additions to, Giovanni-4. One short piece of news: migration of the first full Giovanni-3 portal, for Ozone Measuring Instrument (OMI) data, to Giovanni-4. The Integrated Multi-satellitE Retrievals for Global Precipitation Measurement (IMERG) data are being added to the system. IMERG includes the highest temporal resolution data ever featured in Giovanni – half-hourly precipitation estimates.

And, of course, we have another slogan. If the readership has any ideas for slogans, just send them to me, james.g.acker@nasa.gov.

Until next time, Jim Acker, *The Giovanni News* Editor

## Did you know…


**… that there is a Giovanni image in the book *The Science of Interstellar*, by Kip Thorne?**

***Paper :***

**Zhang, Y., Smith, J., Luo, L., Wang, Z., and Baeck, M. (2015) Urbanization and rainfall variability in the Beijing metropolitan region. *Journal of Hydrometeorology*, doi:10.1175/JHM-D-13-0180.1, in press.**

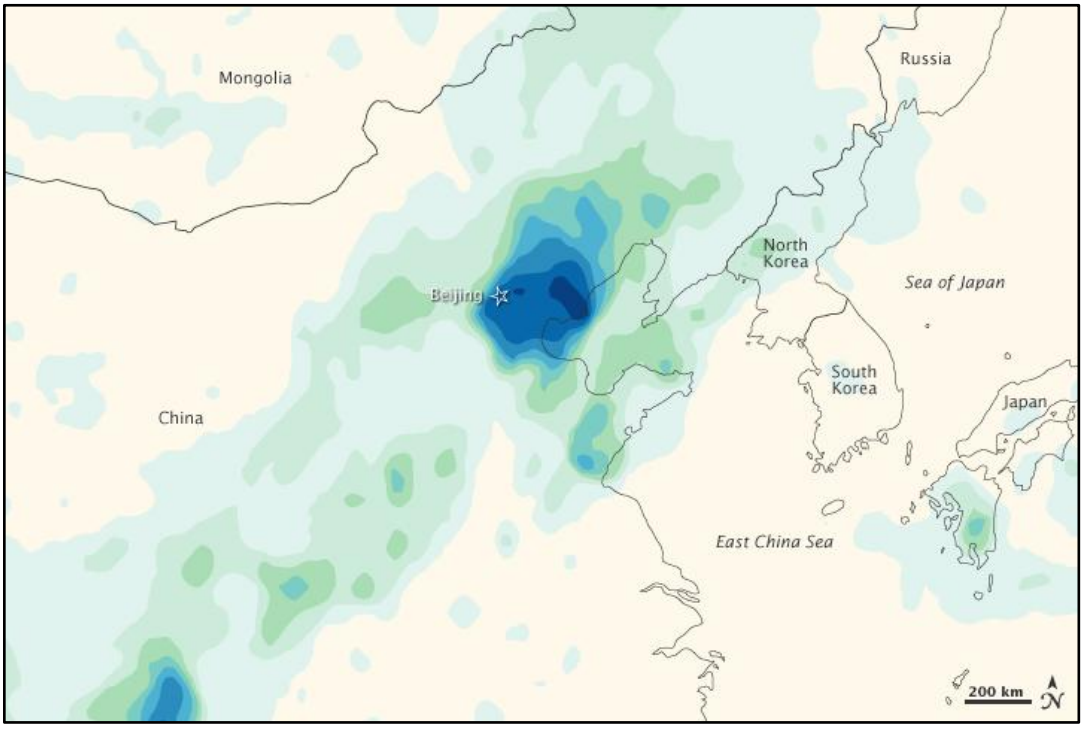
Expansion of the world's megacities has continued in the 21st century. Many meteorological studies have shown that urban areas exert a local weather influence, particularly in terms of temperature, because central urban areas are usually warmer than the surrounding region.

Other studies have shown that the urban environment can alter precipitation patterns. Many factors are implicated, including temperature, air pollution, and humidity (which affects cloud formation).

In the study performed by Zhang, Luo, Wang, and Baeck, the factors influencing precipitation in the Chinese capital city of Beijing were investigated. The researchers specifically examined the effect of urbanization as the city grew during the period 2000-2009. They studied rainfall during the hot summer month of August, when most of the city's warm season rain occurs.

The precipitation data product used in this study was the TRMM Multi-Satellite Precipitation Analysis (TMPA), acquired from Giovanni. TMPA were validated with data from ground stations and weather radar. The primary results were an increase in the frequency of heavy rainfall events and a decrease in the number of days on which rain fell.

The cause of these changes is attributed to "The replacement of vegetated land by urban surface leads to an increase in sensible heat flux and decreases in latent heat flux and ground heat flux. Increases in sensible heat flux lead to increases in the surface air temperature, decreases in relative humidity and an elevated PBL [planetary boundary layer]."




**"The heaviest rainfall in 61 years fell on the Chinese capital city of Beijing on July 21, 2012." TRMM Multi-Satellite Precipitation Analysis (TMPA) image from the NASA Earth Observatory. Article link:**
http://earthobservatory.nasa.gov/NaturalHazards/view.php?id=78626

***Paper :***

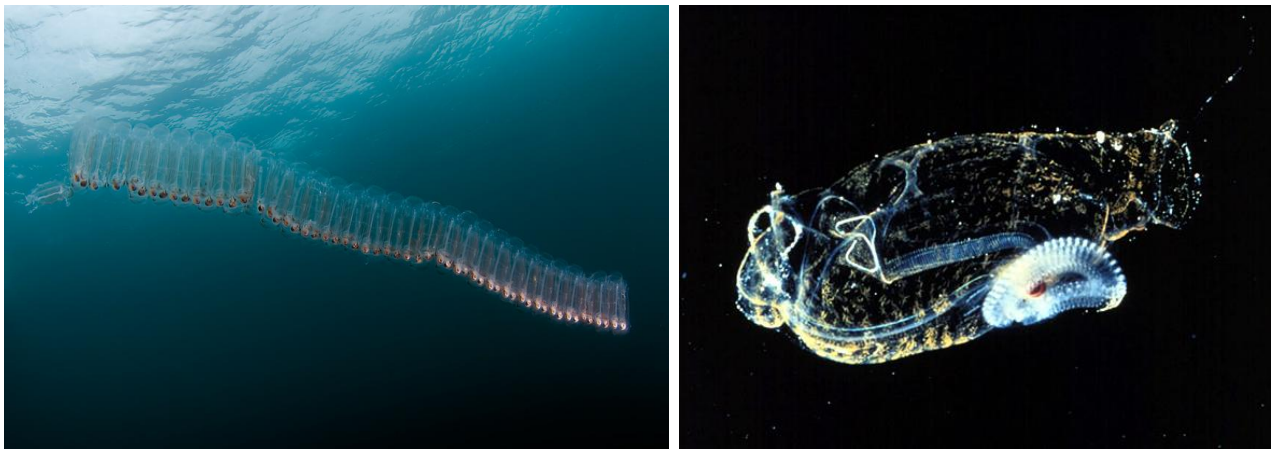
**Giesecke, R., Clement, A., Garces-Vargas, J., Mardones, J.I., Gonzalez, H.E., Caputo, L., and Castro, L. (2014) Massive salp outbreaks in the inner sea of Chiloé Island (Southern Chile): possible causes and ecological consequences. *Latin American Journal of Aquatic Research*, 42(3), 604-621, doi:103856/vol42-issue3-fulltext-18.**

The unassuming name of a ubiquitous aquatic organism – *salp* – does not inspire either dread or delight. And the salp is not one of the ocean's more charismatic fauna, as it primarily consists of a jellylike tube capable of pumping water through itself. Yet, salps can be quite beautiful and impressive, as they are frequently found as long colonial chains, and their glasslike transparency can be stunning. **The two pictures below show a chain of salps and an individual salp.**

Salps consume phytoplankton as filter feeders, pumping seawater through internal filters to capture the phytoplankton cells. One concern regarding salps is that when they proliferate, large numbers of salps can deplete ocean waters of phytoplankton, which is the foundational food source of zooplankton and the larger fauna that inhabit the oceans, from fish to pinnipeds and whales. Salps actually favor water with low phytoplankton populations, because higher phytoplankton numbers can actually clog their internal feeding mechanism.

In 2010, in the inner sea of Chiloé lying off the coast of southern Chile, massive salp outbreaks were observed. The salp outbreaks were accompanied by nearly fourfold reductions in phytoplankton concentration and extensive fish mortality, the latter due to both overconsumption of low-nutrient salps and clogging of gills. This area is particularly important, because it is one of the main regions where salmon is farmed, and salmon is one of Chile's most valuable aquaculture exports.

For this study, MODIS sea surface temperature and chlorophyll data in Giovanni were used to establish general conditions for the period 2002-2011 and to compare these general conditions to the year 2010. The Hybrid Coordinate Ocean Model (HYCOM) was utilized to acquire field data. Outbreaks of the salp species *Ihlea magalhanica* were observed several times in 2010. The research team, led by Ricado Giesecke of the Instituto de Ciencias Marinas y Limnológicas, Facultad de Ciencias, Universidad Austral de Chile, determined that the apparent cause of the salp outbreaks was an unusual intrusion of cold Subantarctic Water (SAAW) into the inner sea of Chiloé. The SAAW water was lower in phytoplankton (as indicated by the chlorophyll concentrations) and also adversely influenced the development of stratification that is conducive to phytoplankton blooms in spring. The two conditions of colder water and lower phytoplankton concentrations in the SAAW were particularly favorably to the life cycle of salps.



Chain of salps (left). Individual salp (right). Individual salp photograph by Larry Madin, Woods Hole Oceanographic Institute.

***Paper :***

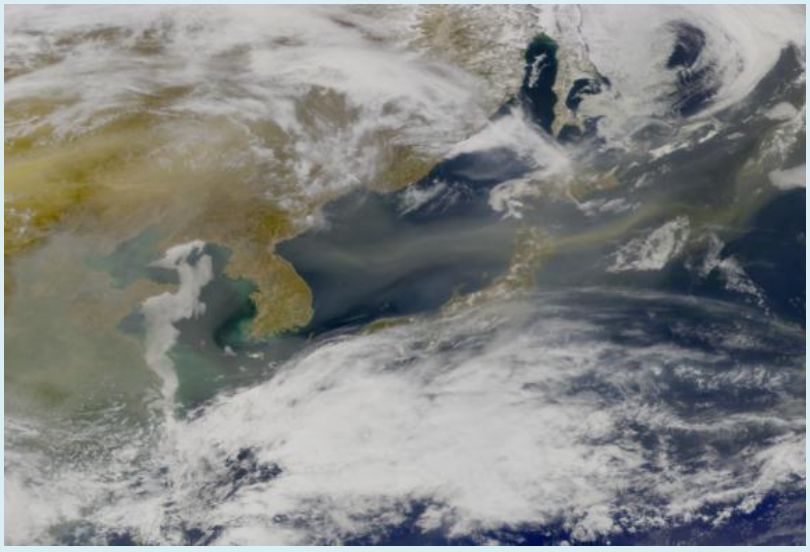
**Creamean, J. M., Spackman, J.R., Davis, S.M., and White, A.B. (2014) Climatology of long-range transported Asian dust along the West Coast of the United States. *Journal of Geophysical Research - Atmospheres*, 119, doi:10.1002/2014JD021694.**

The advent of continuous global remote sensing in the 1990s provided unprecedented insight into the dynamics of dust transport around the world. Remote sensing confirmed that North Africa and the Arabian Peninsula are two important sources of dust for the atmosphere. A third primary source of dust comprises several desert areas in eastern Asia, such as the Taklimakan and Gobi deserts.

Observations from the Sea-viewing Wide Field-of-view Sensor (SeaWiFS) and the Moderate Resolution Imaging Spectroradiometers (MODIS) on the Terra and Aqua satellites showed that major dust storms, particularly those that occur in spring, can transport dust across the Pacific Ocean to the U.S. West Coast. In fact, the largest Asian dust storms can actually transport dust all the way to the U.S. East Coast.

Although atmospheric researchers have long been aware that Asian dust could cross the Pacific, the seasonal impact and actual contribution of Asian dust to the North American "dust budget" had not been quantified until recently. Jessie Creamean, of the National Oceanic and Atmospheric Administration (NOAA) Earth System Research Laboratory, and her colleagues from the Cooperative Institute for Research in Environmental Sciences (CIRES) and the Science and Technology Corporation undertook the creation of a climatology of the impact of Asian dust on the U.S. West Coast. They determined that, although Asian air masses crossed the Pacific Ocean most frequently during the winter, the amount of dust they carried was lower due to increased wet removal by precipitation.

Tropical Rainfall Measuring Mission (TRMM) precipitation data in Giovanni were used to create a precipitation climatology over the Pacific Ocean and U.S. West Coast for the period studied. The spring weather combination, consisting of more frequent Asian dust storm events and lower Pacific Ocean precipitation, meant that Asian dust concentrations were highest in the spring on the U.S. West Coast. The ratio of iron to calcium (Fe/Ca) in dust collected by air sampling was used to distinguish Asian dust from local dust sources. Asian dust averaged 23% of the total fine particulate matter at high mountain sites on the U.S. West Coast in spring.



**SeaWiFS image acquired in 2001 showing Asian dust streaming eastward over the northwest Pacific Ocean.**

***Paper :***

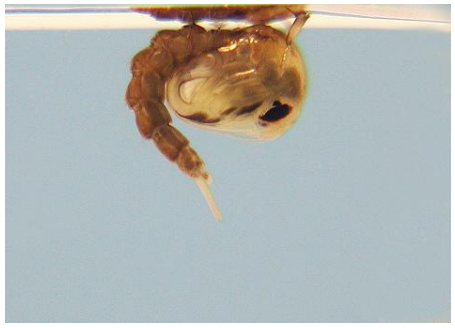
**Moreno-Madrinan, M.J., Crosson, W.L., Eisen, L., Estes, S.M., Estes Jr., M.G., Hayden, M., Hemmings, S.N., Irwin, D.E., Lozano-Fuentes, S., Monaghan, A.J., Quattrochi, D., Welsh-Rodriguez, C.M., and Zielinski-Gutierrez, E. (2014) Correlating remote sensing data with the abundance of pupae of the dengue virus mosquito vector, *Aedes aegypti*, in central Mexico. *ISPRS International Journal of Geo-Informatics*, 3(2), 732-749, doi:10.3390/ijgi3020732.**

**Dengue fever** is one of most feared diseases occurring in the tropics. Symptoms include headaches, severe joint and muscle aches, and skin rashes. The disease can worsen into **dengue hemorrhagic fever**, which has symptoms including bleeding and low platelet levels and can be life-threatening. Even though dengue hemorrhagic fever is fortunately uncommon, dengue fever is a serious disease that affects millions of people every year. The severe phase of dengue fever lasts from 7-10 days, but its aftereffects can linger for months.

Dengue fever is a mosquito-borne disease, carried by the species *Aedes aegypti*. In this study, done by a team led by Max J. Moreno-Madriñán of the Indiana University-Purdue University Indianapolis (IUPUI) Fairbanks School of Public Health and including several NASA scientists, remotely sensed variables were examined for correlation with *A.aegypti* populations in central Mexico. The mosquito population was assessed through the presence and numbers of mosquito pupae in several Mexican cities.

The three variables examined were land surface temperature (LST), precipitation, and elevation. The TRMM 3-hourly 3B42 V7 precipitation data product in Giovanni was used for the precipitation data. MODIS land surface temperature data were acquired from the NASA Reverb/ECHO data system. Elevation data were from the Shuttle Radar Topography Mission.

The strongest correlation was observed between elevation and pupae abundance. Nighttime LST was also strongly correlated, while rainfall was moderately correlated. There was no correlation with daytime LST. The research team stated that the use of remotely-sensed variables in dengue fever predictive models is feasible, but one factor that needs to be further assessed in relation to the disease is socio-economic condition.



**Pupa of the mosquito *Aedes aegypti*, carrier of the dengue fever virus.**

Doubt is the key to knowledge.
(Proverb)
Reduce your doubt;
gain more knowledge

http://giovanni.gsfc.nasa.gov

## *Paper:*

**Jury, M.R. (2014) Weather-climate interactions in the eastern Antilles and the 2013 Christmas storm. *Earth Interactions*, e-View, doi:10.1175/EI-D-14-0011.1.**

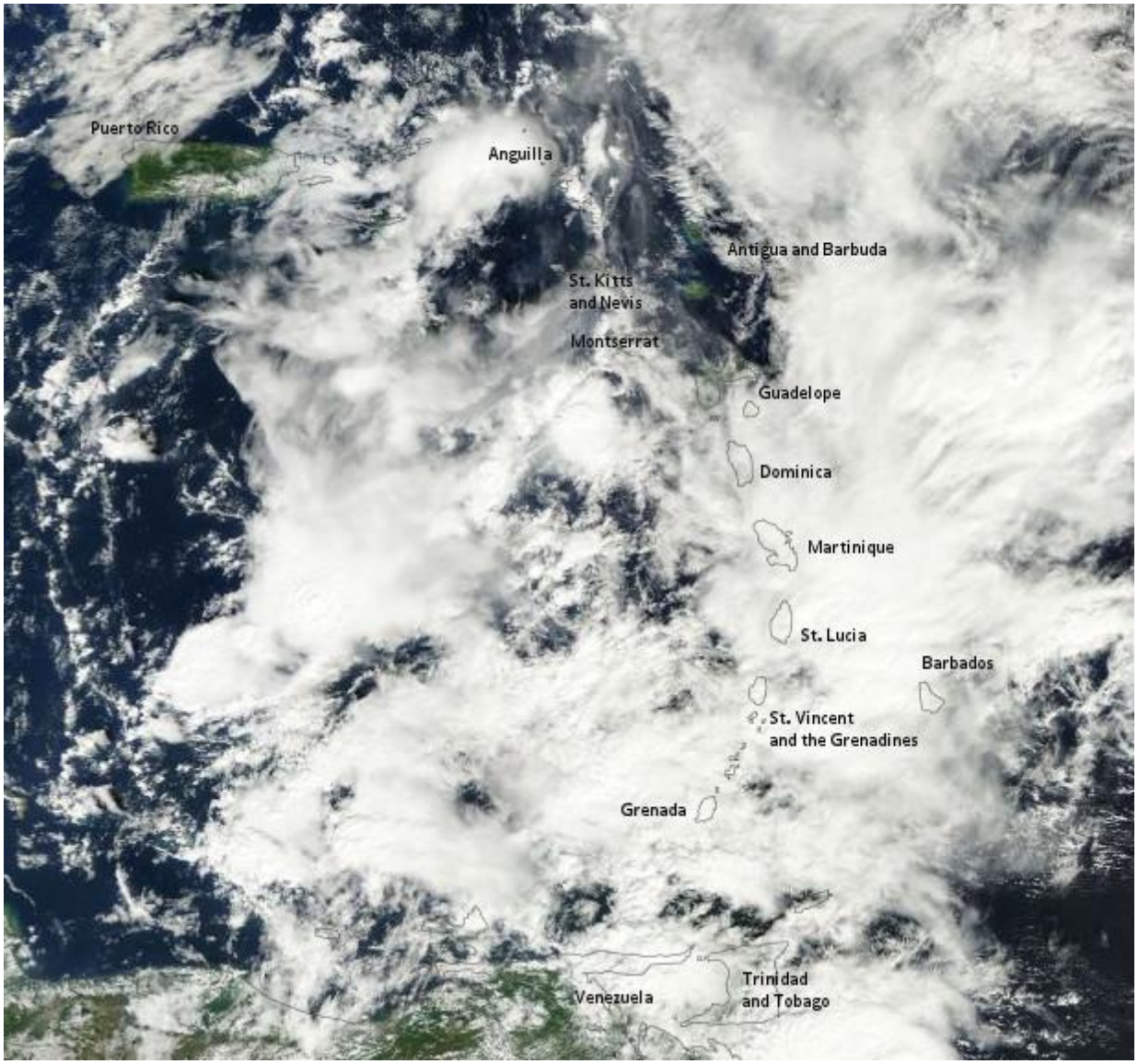
http://thewatchers.adorraeli.com/2013/12/26/heavy-rain-floods-and-landslides-reported-in-eastern-caribbean-on-christmas-eve/

Meteorologist Mark Jury, who divides his academic time between the University of Puerto Rico – Mayaguez and the University of Zululand in South Africa, frequently references the use of the Giovanni data system in his published works. Dr. Jury is an expert in weather and climate interactions, and his research often focuses on the regions where these two universities are located. A 2014 paper published by Jury concerned an event that occurred late in 2013, the "Christmas storm" that impacted several of the islands of the eastern Antilles, causing flash flooding and erosion.

While the chain of islands in the eastern Caribbean is familiar with heavy rainfall due to tropical storms, heavy rain in the winter months is uncommon, which (combined with their tropical ambience) is one reason these islands are favored winter vacation destinations. Jury examined the factors that caused the heavy rainfall of the 2013 Christmas storm, which was atypical due to the low wind speeds associated with the precipitation.

Jury summarized the meteorological factors that caused the storm as two weather elements crossing paths: (1) on the lower level of the atmosphere, a moist convective wave propagated westward and (2) on the upper level, a jet stream trough surged eastward. The interaction of these elements triggered the storm. Rain rates exceeded 30 mm per hour, and accumulation was over 200 mm in some places.

A contributing factor to the elevated rainfall was the sea surface temperature (SST) and salinity regime of the Caribbean Sea. The outflow from the Orinoco River can cover much of the eastern Caribbean with warm, lower salinity water at the surface. In December 2013, the North Brazil Current pushed the Orinoco River plume further northward and created significant potential energy for convection. Jury utilized Global Precipitation Climatology Project (GPCP) rainfall data and Modern Era Retrospective-analysis for Research and Applications (MERRA) data to determine what influences could have led to the heavier winter rainfall. He found that, if upwelling off the Venezuela coast was reduced and the trade winds were weaker, SST in the southern Caribbean would be elevated, causing a wetter November-December in this region. Despite warming temperatures and warmer days, modeled weather conditions actually indicated a decrease in winter flood occurrence frequency, contrary to what intuition might indicate.




**MODIS Image of the 2013 "Christmas Storm."**

***Paper :***

**Long, J., Hu, C., and Robbins, L. (2014) Whiting events in SW Florida coastal waters: a case study using MODIS medium-resolution data. *Remote Sensing Letters*, 5(6), 539-547, doi:10.1080/2150704X.2014.933275.**

There are several different meanings of the word *whiting*, e.g., a variety of fish, a pigment used to make things whiter (as one might expect). The geochemical meaning of the word is the appearance of a suspension of fine white sediments in lake or ocean waters, commonly consisting of calcium carbonate ($CaCO_3$), which forms either as inorganic chemical precipitates- or biologically-mediated chemical precipitates. (A 'precipitate' is a solid material that forms due to chemical processes, usually chemical reactions, in solution. Solutions that are supersaturated with a low-solubility chemical compound may spontaneously form precipitates, especially if "seeded" with fine solid material of some kind. Bacterial cells or biological debris can both act as seed material for precipitation.) The bright blue waters of Lake Ontario, photographed from the International Space Station on August 24, 2013, show a highly visible example of this particular meaning of whiting. Not all natural events called whitings are geochemical in nature; whitings can also be caused by re-suspension of bottom sediments, and coccolithophore blooms have sometimes been called whitings as well.

The research described in the paper by Long, Hu, and Robbins investigated whitings that were sighted off the southwest coast of Florida, immediately west of the Ten Thousand Islands coastal region that constitutes the western side of the Everglades National Park. The three researchers used the highest spatial resolution data available from MODIS, 250 meters, to look for whiting events over the period of December 2010 to November 2013. The seasonal frequency of the events was categorized using the full database of observed whitings. Whitings occurred most frequently in the spring and autumn months, while no events occurred in the winter months and very few happened in the months of summer.

Data products available in Giovanni were used to examine potential causes of these whitings. These data products included precipitation, wind speed, photosynthetically available radiation (PAR), and sea surface temperature (SST). The only definite association found was whitings occurred when SST was between 25-29 degrees Celsius. Both the composition of bottom sediments and the low wind speeds associated with many of the events did not favor re-suspension of bottom sediments as an explanation. The possibility that these whitings could be caused by biologically-induced $CaCO_3$ precipitation by cyanobacteria, as has been observed around the Bahamas Banks, could not be examined, because the waters where the whitings occurred were not tested for cyanobacteria.

Lake Ontario, August 24, 2013, in the midst of a whiting. (ISS astronaut photograph)